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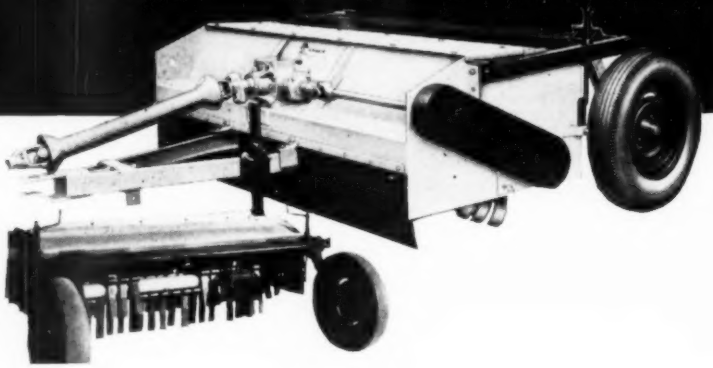

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SUSTAINING MEMBERS

EFFECT OF FERTILIZER ON THE CHIPPING QUALITY OF FRESHLY HARVESTED AND STORED RED RIVER VALLEY POTATOES[1]

Herbert Findlen[2]

Because of changes in the cropping system, potato growers in the Red River Valley of Minnesota and North Dakota have tried to maintain yields by increasing the percentage of nitrogen in the fertilizer. At the same time more and more potatoes are being grown for the potato chip industry. It has been suggested that chips made from stored potatoes grown on soils high in nitrogen were of poor color. In addition, previous work in the Red River Valley (2, 3) showed that potash fertilizers containing chloride, the most widely used form, lowered the dry-matter content of potatoes. This would reduce the yields of chips, as shown by numerous investigators and reviewed by Talburt and Smith (15).

The present study was undertaken to determine the effect of nitrogen, phosphorus, and potassium fertilization on chipping quality of freshly harvested and stored potatoes.

Materials and Methods

In 1956 a 3 x 2 x 2 split-plot factorial design was used with 4 completely randomized blocks. The fertilizer was applied as follows: 0, 30, and 60 pounds per acre of nitrogen (N_0, N_1, and N_2), and O and 60 pounds per acre of phosphorus and potash (P_0 and P_1, and K_0 and K_1) applied in bands in the row slightly below and to each side of the seed piece at planting time. These rates were selected because previous work(10) showed that they were within the range likely to produce optimum yields. The 4-row plots — 80 feet long — were split into two 40-foot plots; one was planted with the Irish Cobbler variety; the other with Kennebec. Records were obtained from samples from only the two center rows to preclude any border effect of adjacent plots. The potatoes were grown on non-fallow Bearden silt loam typical of the better soils of the Red River Valley. The potatoes were planted on May 21, the vines were killed by mechanical beating on September 5, and the potatoes were harvested September 10.

Chips were prepared within 4 days after harvest. Additional samples were stored in a commercial storage house at about 40° F. until February 4, 1957, then reconditioned 3 weeks at 80° prior to chipping February 25. In the statistical analysis of the results, the main effects were partitioned into individual degrees of freedom by the method of Yates (16) to test the linear and quadratic components of N and its interaction with P, K, and varieties for significance.

In 1957 chips were prepared at harvest time only from a single replication of a fertilizer trial conducted by the Minnesota Agricultural Experimental Station with the Irish Cobbler variety on both fallow and

[1]Accepted for publication August 24, 1959.

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non-fallow Bearden silt loam soils. The soil was fertilized with 0, 60, 120, and 180 pounds per acre of nitrogen; 0, 60, 120 pounds per acre of phosphorus; and 0 and 60 pounds of potash in various combinations.

Experimental lots of potatoes weighing about 2,000 grams, each containing 10 tubers of about the same size, were used for the chipping tests. Except where otherwise noted, samples were obtained from each replication. For each chipping test the potatoes were peeled in an abrasion peeler and several transverse slices about 3/64-inch thick were taken from near the center of each tuber to make a composite sample weighing exactly 100 grams. The sample was rinsed in 3 changes of cool tap water to remove adhering starch grains, blotted between cotton towels, and fried in peanut oil at 340° F. in a thermostatically controlled electric fryer holding about 15 pounds of oil. The sample was removed from the fryer when the oil ceased to bubble. Each sample was weighed to determine percentage yield and was then scored for color using the following scale. Chips that were very dark brown scored 50 or less; dark brown, 55 to 65; medium brown, 70 (lowest salable grade); light brown, 75 to 85; and cream, 90. The most desirable color for most consumers is in the 80 to 85 range .

Results and Discussion

Data on yields as affected by the fertilizers are not presented here because extensive data appear elsewhere (10, 13).

Chip color.—At harvest time in 1956 lighter colored chips were made from the Kennebec variety than from Irish Cobbler. The difference was highly significant. However, none of the fertilizer treatments had any significant effect on chip color.

Somewhat similar results were obtained following storage at about 40° F. and reconditioning at 80°. All lots yielded chips of darker color than at harvest, however, and there was a greater difference between varieties. In addition, a significant interaction occurred between varieties and phosphorus and potash applications. Phosphorus resulted in significantly darker chips from Kennebec potatoes when potash was absent but had no effect when potash was present (Table 1). The cause of this effect is unexplained at present and should be regarded with caution until further evidence has accumulated. None of the main effects of N, P, or K or the remaining interaction was significant.

In 1957 an application of up to 180 pounds per acre of nitrogen, 120 pounds of phosphorus, and 60 pounds of potash in various combinations on both fallow and non-fallow soils had no discernible effect on the color of chips prepared shortly after harvest from Irish Cobbler potatoes. Since these high applications of fertilizer had no effect on chip color, chips were prepared from only a single replication.

These results are in general agreement with the results of Denny and Thornton (1), working with the White Rural variety in New York, and Salunkhe, Wheeler, and Dexter (11), working with several varieties in Michigan. They are somewhat in contrast, on the other hand, with the work of others. Thus, Habib (6) reported that Katahdin potatoes grown at a high nitrogen level resulted in chips of significantly better color. This is supported in part by the work of Sawyer and Dallyn (12), working

TABLE 1.—*Mean color ratings[1] of chips made from potatoes grown with 2 levels each of phosphorus and potash fertilizers. (Stored at about 40° F. until Feb. 4, then reconditioned 3 weeks at 80° prior to chipping.)[2]*

Variety	K_0		K_1		Mean[3]
	P_0	P_1	P_0	P_1	
Irish Cobbler	63	63	64	62	63
Kennebec	74	68	71	73	72

[1]Scale of color ratings: Very dark brown, 50 or less; dark brown, 55 to 60; medium brown (lowest salable grade), 70; light brown, 75 to 85; cream, 90.
[2]L.S.D. between individual values at 0.05 level = 3.
[3]Means significantly different at 0.01 level.
K_0 and P_0 = No K and P
K_1 and P_1 = 60 pounds of K and P

with both the Irish Cobbler and Katahdin varieties on Long Island, who stated that there was a tendency for tubers receiving all of the nitrogen (up to 175 pounds per acre) at planting to chip lightest.

Conversely, Smith (14) reported that potatoes grown with 50 pounds of nitrogen per acre in a complete fertilizer produced tubers which made lighter chips than did those from plants grown with 75 to 150 pounds. Murphy and Goven (9) presented data obtained in Maine which showed a trend towards poorer chip color as the nitrogen application rate was increased. The results were most striking with the Katahdin variety at rates of 180 pounds per acre and higher, but to a lesser extent with Kennebec and Russet Burbank. With the Kennebec and Russet Burbank varieties, chips of satisfactory color were processed from potatoes at the nitrogen rate that produced optimum yields. With the Katahdin variety, however, the nitrogen rate which produced optimum yield resulted in chips that were slightly too dark to be desirable. Eastwood and Watts (4) obtained variable results and concluded that the use of nitrogen above that required for adequate production did not consistently and definitely improve chip color.

Kunkel and Smith (7) obtained indications that heavy applications of potash result in potatoes which produce lighter colored chips than do those with lower amounts. Eastwood and Watts (5) also reported that the higher levels of potash tended to improve chip color slightly but were of doubtful commercial value. Murphy and Goven (8) reported that use of sulphate of potash had a tendency to produce darker colored chips than did potassium chloride. There was also a trend for the higher rate of sulphate (240 pounds per acre) to produce lighter colored chips than the lower rate (120 pounds) but the difference was not statistically significant during the 3 years of the study. This latter effect did not occur with potassium chloride.

The variable results reported by the several investigators can probably be attributed to the different climatic and soil conditions under which the experiments were conducted and to different potato varieties and amounts of fertilizers used. In many instances the differences reported are rather small and of questionable commercial significance.

Chip yield.—Average chip yields at harvest time for certain of the fertilizer treatments are shown in Table 2. The yields were calculated as a percentage of peeled, raw, sliced potato weight and therefore are not comparable to commercial yield figures which are based on the weight of unpeeled potatoes. For both varieties together the effect of nitrogen was proportional to the amount applied. However, the decrease in chip yield with the highest level of nitrogen (60 pounds per acre) as compared with the lowest (none) was only 0.2 per cent with the Irish Cobbler variety and this decrease was not significant at the 0.05 level. With the Kennebec variety, the highest level of nitrogen decreased yield significantly by 1.3 per cent as compared with the lowest level.

TABLE 2.—*Mean yields of chips made at harvest time from Irish Cobbler and Kennebec potatoes grown with 3 levels each of nitrogen in 1956.*

Variety	N_0[1]	N_1	N_2	Mean[2]
	Per cent	Per cent	Per cent	Per cent
Irish Cobbler	35.1	34.5	34.9	34.8
Kennebec	34.9	34.1	33.6	34.2
Mean[3]	35.0	34.3	34.2	--

[1]L.S.D. between nitrogen levels with each variety at 0.05 level = 0.7.
[2]Means significantly different at 0.01 level.
[3]L.S.D. between nitrogen level means at 0.01 level = 0.6.

N_0 = No nitrogen
N_1 = 30 pounds nitrogen
N_2 = 60 pounds nitrogen

The plots that received 60 pounds of potash per acre resulted in chip yields of 34.1 per cent as compared with 34.9 per cent with those that received no potash. The decrease due to potash application, although relatively small, was highly significant.

The Irish Cobbler variety gave a higher average chip yield than the Kennebec variety. The difference was not large but was highly significant. The greatest difference between varieties occurred with the highest level of nitrogen.

Following storage and reconditioning, the average response of chip yield to nitrogen application continued to be essentially linear with the highest level of nitrogen decreasing chip yield 0.8 per cent below that of the lowest rate. There was no sign of a main effect due to potash but the variety x potash interaction was significant. Potash lowered chip yield slightly with Irish Cobbler but had no apparent effect with Kennebec. The varietal response was similar to that which occurred at harvest time but the difference just failed to be significant at the 0.05 level.

SUMMARY

Potato chips were prepared at harvest and after a period of storage and reconditioning from Irish Cobbler and Kennebec potatoes grown with several different levels of nitrogen, phosphorus, and potash fertilizers applied at planting time.

The fertilizers had no important effect on chip color.

In general, the higher rates of nitrogen application reduced chip yield slightly. This effect was particularly noticeable with the Kennebec variety at harvest time. Chip yields were also slightly lower when potash was present in the fertilizer than when it was absent.

Chips prepared from the Irish Cobbler variety were of slightly poorer color but with slightly higher yield than the Kennebec variety.

Acknowledgment

The author wishes to express his appreciation to J. C. Hansen, formerly Assoc. Hort., Biol. Sci. Branch, Agr. Mktg. Serv., U. S. Dept. of Agr., for assistance in carrying out the study; to Dr. A. C. Caldwell and H. W. Kramer, Minn. Agr. Exp. Sta., for supplying samples of potatoes from a fertilizer trial; to the N. Dak. Agr. Exp. Sta., for the use of a special potato planter; to E. E. Houseman and E. J. Koch, U. S. Dept. of Agr., for advice on the statistical analysis of the results; to the Red River Valley Potato Growers Assoc., for furnishing the potatoes; and to the Summers Fertilizer Company, Inc., for supplying some of the fertilizer materials used.

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POTATO LEAF ROLL VIRUS: A SERIOUS TROUBLE IN MAINTAINING HEALTHY SEED POTATOES IN ARGENTINA[1]

M. V. FERNANDEZ VALIELA[2]

Toward the end of the last century, potatoes gradually became an important crop in the southeastern part of the province of Buenos Aires, namely in the counties of Balcarce, Mar del Plata, and Tandil. Today, these counties represent the country's most important potato producing area. Since these early days until only a few years ago when the Huincul variety, a local selection, became extensively used, growers depended upon periodical importation of potato seedstock from foreign countries. There was considerable reduction of importations between 1921 and 1936, due to the fact that local seed potatoes were available from two foreign strains which were being multiplied in the country. One of these strains known as "Nortemericana larga" or "Blanca" originated from stock introduced from the United States in 1915, and used until about 1936. The other, known as "Chaquena" was selected from another U. S. importation released to the market in 1925. This stock was extensively used until 1936. (1).

As infection by the leaf roll virus became more and more severe (2) the two above mentioned strains were lost during 1935 and 1936. This was due to the increase of aphids in the southeastern portion of the province of Buenos Aires. Not only was there a loss in local seed potato production, but also in foreign markets which absorbed production surplus. During 1936 and 1937 different official organizations and commercial concerns introduced and tested more than 100 European and North American potato varieties with the purpose of finding one which could adequately replace the two which had been lost.

None of the varieties showed promise when tested under local conditions and subjected to the common cropping techniques of Argentina's important potato producing areas. After two or three generations all varieties tested dropped their production levels well below their former standards. Although Katahdin behaved similarly to the other varieties in this respect, necessitating the periodical renewal of all seed stock every 3-4 generations from U. S. or Canada, it showed very good adaptability in different regions of the country. Thus, around 1948 this variety composed more than 90 per cent of all the acreage devoted to potatoes in Argentina. Since the introduction in 1950 of Huinkul, a selection of the Balcarce Experimental Station, it has increased in use until by 1957 it composed 70 per cent of all the potato production in the southeast of the province of Buenos Aires.

Under the common cropping practices of this area where no preventive method is used to combat virus diseases, no imported varieties could maintain their productivity after two or three generations. In the case of the Katahdin this meant poor sprouting; lack of uniform stands; a tendency

[1]Accepted for publication September 28, 1959.
[2]Director, Delta del Parana Experiment Station, Argentina.

for each plant to produce just one or very few, usually erect, stalks; shortening of the growth and resting periods; and general reduction of yields which finally became stabilized at a constant low level. With only very few exceptions, outer symptoms of the virus diseases, such as leaf roll, mosaics, etc., were never present. "Top necrosis", caused by *Lycopersicum* virus 3, could be observed in varying degrees during some years, but in the case of Katahdin its transmissibility by means of tubers is very low, ranging around 0.6 per cent (*2*).

Some experiments have proved that individual Katahdin plants, showing these degenerative traits, but no direct and evident symptom of the leaf roll virus, can cause *Physalis floridana* to show definite symptoms of the leaf roll virus when the aphid *Myzus persicae* (Sch) is allowed to feed on these plants and later are transferred to *P. floridana.* During 1958, tests were carried out with three and five-generation Katahdin plants, from the southeastern area of the province of Buenos Aires. On *P. floridana* they showed 41 per cent and 80 per cent leaf roll virus infection. On the other hand, when leaf roll infested Katahdin potatoes are grown in summer and winter under greenhouse conditions, they show characteristic symptoms only during the winter period, and when offspring of these plants are grown during summer they develop normally (Figure 1). Additional experiments have shown that poor sprouting is directly related to leaf roll virus infection, for this condition does not occur when healthy seed potatoes are used for planting.

FIGURE 1.—Katahdin with leaf roll virus grown under greenhouse conditions in winter (left) and summer (right).

Materials and Methods

Based upon the assumption that lack of adaptability is caused by leaf roll virus, the high valleys of the Andean foot-hills have been explored since 1948 in order to find suitable seed potato producing areas which would not only offer isolation from common potato populations, but also a lower proportion of insect vectors and better winter storage of the tubers. The first tests were carried out with the Katahdin, Pontiac, White Rose and Chaquena varieties, of which the first three had been introduced during 1947 and had already been multiplied four times in the southeastern potato areas of the province of Buenos Aires. It is important to bear in mind that this seed potato stock had been selected from apparently healthy and vigorous stands, and during the years 1951 and 1952 was grown in the high valleys of the province of San Luis at about 5,400 feet above sea level, together with other common crops and without any special preventive treatment against insect vectors. After two generations in these high valleys, an early test was carried out in the fields of the Plant Disease Laboratory of the Parana Delta, and the following percentages of plants with severe leaf roll virus infection was obtained (Table 1 and Figure 2).

Table 1.—*Percentages of plants with leaf roll infection after 2 generations (1951-52) of growth in San Luis valley which stocks were supposed to have been infected with symptomless leaf-roll before being sent to this valley.*

Variety	Plants Tested	Plants with Leaf-Roll
	Number	Per cent
Pontiac	556	95
White Rose	338	93
Katahdin	180	97
Chaquena	306	98

Later, from 1953 untill 1956, smaller quantities of certified varieties were grown, these being Katahdin imported from Canada, and Majestic and Up-to-Date, both introduced from Sweden. Again no preventive steps were taken against insect vectors, and after three years, an early test produced the results in Table 2.

Although this test was carried out during a different period, it proves that the leaf-roll virus infiltration in the San Luis valley is not so important as had been indicated by analysis of the data obtained from the previous test, making it possible to assume that the high percentage of the virus infiltration noted then was actually nothing more than a "coming to evidence" of symptoms which formerly had remained unnoticed.

It was also noticed that varieties which declined rapidly in the mild climate of the southeastern area of the province of Buenos Aires, thrived well in the high valleys of the San Luis Province and thus it has been possible to maintain foundation stock of Irish Cobbler, Saco, Merrimack, Mohawk, Kennebec, Teton, Sebago, Chippewa, Cherokee, Green Mountain, Pungo and Pontiac, all originating from foundation stock kept at Masardis Farm, Presque Isle, Maine, and kindly made available to us in 1955 by Mr. E. L. Newdick. All common practices for the maintenance of foundation stock have been rigorously observed since their introduction, *i. e.*

FIGURE 2.—Uncommon symptoms of virus leaf roll on Katahdin grown at 5,400 feet in the Andenean valleys.

TABLE 2.—*Percentages of plants with leaf roll infection after 3 generations (1953-56) of growth in San Luis valley which stocks were supposed to have been healthy before being sent to this valley.*

Variety	Plants Tested	Plants with Leaf-Roll
	Number	Per centt
Katahdin	87	8.0
Up-to-Date	110	18.1
Majestic	82	20.7

healthy seed potatoes, planting in tuber units, destruction of the diseased or suspicious plants, adequate treatment against insect vectors, tuber indexing or early "healthy" test, etc.

Although the danger of leaf-roll infection was ever present, it was possible to establish that after four generations, health and yield could be maintained at a constant level. This enabled us to assume that with strict observance of the described practices for maintaining foundation stock it will

be possible to keep such varieties indefinitely free from degeneration. This proves, at least under the conditions prevailing in the high valleys of San Luis, that if the leaf-roll virus is controlled, degeneration or lack of adaptability of different varieties which could not formally be maintained in Argentina can likewise be controlled.

Summary

Under the ecological and common cropping practices prevailing in the main Argentine potato producing areas, it has been noted during the last twenty years, that of more than one hundred foreign varieties which were introduced and subsequently tested, none showed adaptability, their yields falling sharply after two or three multiplications.

All available experimental data indicate that leaf-roll virus unaccompanied by its characteristic visible symptoms, is the main cause for this lack of adaptability. In the specific case of Katahdin, this expresses itself by poor sprouting, uneven growth, poorly developed plants, shortening of the growth and rest period, and very evident decreases of yields.

When potatoes are grown at about 5,400 feet above sea level in the high valleys of the Andean foot hills, and subject to the necessary treatments to prevent virus disease infection, the foresaid degeneration does not occur and the only factor related to it is the leaf-roll virus, which then constitutes the only menace for the keeping of healthy foundation stock.

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TOBACCO MOSAIC VIRUS CARRIED IN POTATO TUBERS[1]

HENNING P. HANSEN[2]

The potato plant has occasionally been reported as a host of tobacco mosaic virus (Johnson, 5; Fernow, 2; Blodgett, 1; Kausche,8; Johnson, 6; Johnson & Ogden, 7; Valleau & Johnson, 11, a.o.)

In 1925 Johnson found that tobacco mosaic virus (TMV), when sap-inoculated to the potato variety Bliss Triumph induced brown or black necrotic local lesions at the points of inoculations, but no systemic infection. The same year Fernow reported systemic infection with severe necrosis and leaf-drop in Green Mountain potatoes, when TMV was inoculated by grafting. Blodgett (1) observed both kinds of reactions. He stated that TMV induced different symptoms on different potato varieties, and, like Fernow, he also reported tuber-transmission of TMV to the next potato-generation, the affected second year plants showing extreme dwarfing and leaf-dropping. Furthermore, he stated that marked symptoms were obtained only at relatively high temperatures, about 26° C. and above.

The object of the present paper is a ringspot strain of TMV, which was found spontaneously tuber-borne and therefore might be supposed to possess a higher potentiality than the ordinary TMV for continuous propagation in the potato plant.

This strain of TMV was found in a certain clone, No. 67a, of Solanum *commersonii* Dun. subsp. *malmeanum* (Bitter.) Hawkes (= *S. millanii* Buk. & Lechner). The clone has been collected, together with a number of other "wild" potatoes, by members (Petersen & Hjerting) of a Danish botanical expedition to South America. Its place of origin is the Argentine province Missiones.

The plants of this particular clone have a somewhat diseased appearance (Figure 1): a low type of growth, rather rigid leaves with a diffuse, interveinal yellowing.

Sap-inoculations to a number of indicator-plants were undertaken and resulted in infections as follows:

Nicotiana glutinosa reacted with a type of local lesions indistinguishable from those characteristic of TMV.

Datura stramonium: small necrotic local lesions of the same type as from TMV, followed by a systemic, although often latent infection; a certain amount of yellowing frequently occurs, and in individual cases stem-necrosis with cavities in the pith.

Tomato, *Lycopersicum esculentum*: a rather mild mosaic disease, sometimes the discolored patches are ringlike; in general there are no malformations in tomatoes .

Cucumis sativus, Convolvulus arvensis and *Tropaeolum majus* are not susceptible by sap-inoculation.

Tobacco, *Nicotiana tabacum* var. White Burley and Samsun, react with light-green, nonnecrotic primary spots as with other TMV strains.

[1]Accepted for publication October 15, 1959.
Contribution No. 53 from the Department of Plant Pathology. Invitational paper, presented at the 43rd Annual Meeting of The Potato Association of America. University of New Brunswick, Fredericton, N. B., Canada, August 1959.
[2]Virological Laboratory, The Royal Veterinary and Agricultural College, Denmark.

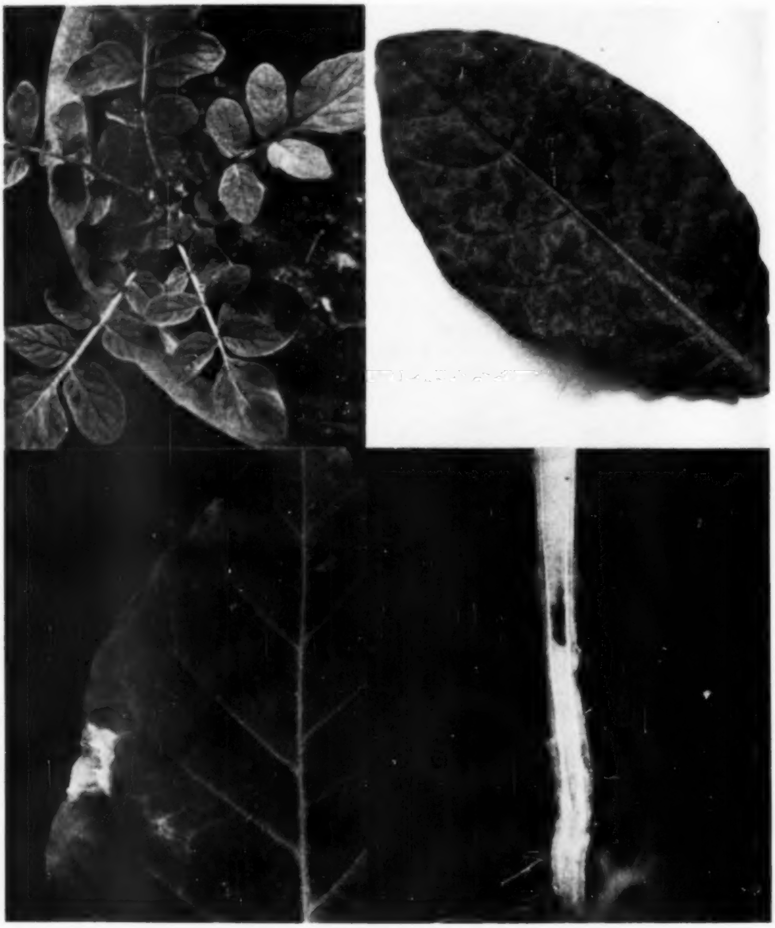

FIGURE 1.—Upper left: *Solanum commersonii* Dun. subsp. *malmeanum* (Bitter) Hawkes, clone nr. 67a (Petersen and Hjerting).

The described "strain 67a" of tobacco mosaic virus (TMV) was isolated from this clone, in which it occurred spontaneously tuber-borne.

Upper right: Leaf of tobacco, *Nicotiana tabacum* L. with ring-and line-pattern induced by TMV strain 67a.

Lower left: Tobacco leaf with sporadic light green and necrotic ringlike blotches induced by TMV strain 67a.

Lower right: Tobacco stem split open to show the pith-necrosis sometimes induced by TMV strain 67a.

The subsequent symptoms induced by this particular strain vary considerably. They have a special tendency to be ringlike, sometimes to the extent of white or necrotic ring- and line-patterns as shown in figure 1, upper right. However, in general, tobacco plants react with a mild mosaic or the infection remains latent with the exception of sporadic light-green or necrotic rings (Figure 1, lower left). In several cases stem-necrosis occurs, visible from the outside as depressed, light-brown or dark areas. The pith inside is blackish and often hollow (Figure 1, lower right); such cavities may occur everywhere along the length of the stem, resembling the "pith-chambering" described as a characteristic of the Rotterdam-B disease of tobacco in Sumatra (Jochems 4).

The Rotterdam-B disease is caused by a soil-borne virus with particles of the same type as TMV and is also known to affect potatoes. The characteristics place it between the soil-borne tobacco-rattle virus and TMV. It cross-protects against, but is not serologically related to TMV (Thung & Hadiwidjaja 10).

The virus from *Solanum commersonii* in Argentine was compared with ordinary TMV, a distorting strain called N-1, which is symptomatically very different and which originally was isolated from a Danish tobacco field in 1942 (Hansen 3). It has been kept in dry leaves for a period of 6 years.

Antisera were prepared against both viruses and both reacted vigorously with antiserum against the other virus. By cross-absorption tests a minor antigenic difference was observed, but not more than generally found between other strains of the same virus. The ringspot strain from "wild" potato also protected tobacco plants against the ordinary strain TMV; therefore it is a strain of the same virus species.

The physical properties of the two strains were compared. The thermal inactivation point of the ringspot strain was a little lower: between 88° and 90° C., whereas, the distorting strain (N-1) is inactivated a little above 92° C. for ten minutes. The dilution end-points of both strains are above 10^{-6}, although the ringspot strain appears to be less concentrated than the distorting strain. Both strains were still infective in expressed sap tested comparatively after 5½ months at room temperature. Both were similarly precipitated by ammonium sulphate, *etc.* and by high-speed centrifugation; purified preparations of both show anisotropy of flow in polarized light . .

Some attempts were made to determine if the ringspot strain has soil infection, but no evidence was obtained. This is a further important distinction from Rotterdam-B virus, stem-mottle and certain other ringspot viruses.

The relation to various commercial potatoes, as well as to some "wild" tuber-bearing Solanum species from South America, was tested. The plants were inoculated by rubbing carborundum-dusted leaves with virus-soaked cotton. With commercial potato varieties parallel comparative experiments were carried out with the ordinary as well as with the ringspot strain of TMV. No essential difference in the reactions was observed.

Each of the ten commercial potato varieties tested reacted with local lesions or blotches (Figure 2, left), and they might also be more or less systemically infected in the current year, although rarely. Neither of the two strains of TMV were tuber-borne to second year plants of these varieties.

TABLE 1.—*The reactions of various tuber-bearing Solanum species on tobacco mosaic virus.*

Solanum Species and Clone	Current Year Symptoms		Second Year Symptoms	Tuber-borne TMV	Progeny-tests No.
	Inoculated Leaves	Other Parts			
S. tuberosum					
Var. Juli	Local lesions and dropping	Apparently healthy*	Apparently healthy	—	1284, 1307
" Ersteling	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1285
" Up-to-Date	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1308
" King Edward	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1287
" Sharpes Express	Local lesions and dropping	Apparently healthy*	Apparently healthy	—	1277, 1286
" Di Vernon	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1252, 1281 a.o.
" Alpha	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1280
" Katahdin	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1309
" Flava	Local lesions and dropping	Necrotic spots	Apparently healthy	—	1251, 1283 a.o.
" Bintje	Wilting blotches and dropping	Apparently healthy	Apparently healthy	—	1250, 1288 a.o.
S. tuberosum x *S. demissum*					
Clone A-6 (E. Köhler)	Watersoaked blotches and bright yellowing	Bright yellows and rapid death	Apparently healthy	—	1218
S. microdontum Bitt.					
Clone 364 P. & H.	Yellow blotches with brown margins	Apparently healthy	Apparently healthy	—	1312
S. chacoense Bitt.					
Clone 152 P. & H.	Local lesions and dropping	Apparently healthy	Apparently healthy	—	1311
Clone 84 P. & H.	Local lesions and dropping	Apparently healthy	Not sprouting tubers		
Clone 1889 P. & H.	Local lesions and dropping	Apparently healthy	Tuber necrotic		
Clone 349 P. &H.	Local lesions and dropping	Etched small rings and spots	Suspicious (an etched line)	—	1314
Clone 56 P. & H.	Local lesions and dropping	Mosaic and malformation	Mosaic and malformation	+	1278, 1306

Solanum Species and Clone	Current Year Symptoms: Inoculated Leaves	Current Year Symptoms: Other Parts	Second Year Symptoms	Tuber-borne TMV	Progeny-tests No.
S. acaule Bitt.					
Clone 1897 P. & H.	Local lesions and dropping	Necrotic spots	No tubers		
Clone 353 P. & H.	Local lesions and dropping	Mosaic and malformation	Mosaic and malformation	+	1316
Clone 1898 P. & H.	Local lesions and dropping	Mosaic and malformation	Mosaic and malformation	+	1289
S. famatinae Bitt. & Wittm.					
Clone 1892 P. & H.	Apparently healthy	Apparently healthy	Apparently healthy	—	1313
Clone 1895 P. & H.	Local lesions and dropping	Necrotic spots and malformation	Mosaic and malformation	+	1317
S. megistacrolobum Bitt.					
Clone 255 P. & H. / Clone 366 P. & H. / Clone 251 P. & H. / Clone 316 P. & H.	Systemic acropetal-necrosis; death generally within 2 weeks.		No tubers		
S. vernei Bitt. & Wittm. subsp. *ballsii*, Clone 351	Systemic acropetal-necrosis and severe dwarfing.		No tubers		
S. commersonii Dun. subsp. *malmeanum* Bitt. Hawkes Clone 67a	Systemic diffuse, interveinal yellowing; spontaneously containing a strain of tobacco mosaic virus.			+	1310, 1318 and others

*In some cases a few necrotic spots.

FIGURE 2.—Left: Leaf of potato, *Solanum tuberosum* L. var. Juli, with local lesions induced by rubbing with TMV strain 67a. Other commercial potato varieties tested respond similarly on inoculation with this and other strains of TMV under high temperature conditions.

Right: Three plants of *Solanum chacoense* Bitter the middle one of which is second-year infected with TMV strain 67a. It shows stunting in addition to mosaic and malformation of leaves. The control plant on the right is healthy, the one on the left is infected with potato virus X.

Some clones of other "wild" *solanum* species react similarly and transfer TMV strain 67a through tubers (see Table 1).

When inoculated under field conditions, only a few local lesions appeared. The difference from the often numerous local lesions in glasshouse tests is probably a matter of temperature, as already observed by Blodgett in 1927.

Some of the "wild" potatoes react similarly, whereas others become systemically infected and regularly carried the virus in the tubers (Figures 1, upper left, 2, right). The systemic symptoms induced by the ringspot strain in these potato species most often consist of mosaic and malformations, particularly narrowing of the leaves, green blisters and general stunting. A survey of the various reactions is shown in Table 1.

It may be concluded that the spontaneously occurring tuber-borne virus is a strain of TMV with symptomatic resemblance to Rotterdam-B, rattle and certain ringspot viruses in tobacco plants, but it appears not to be soil borne. The ringspot strain is not generally tuber-borne in commercial potatoes, at least not in the ten varieties tested by sap inoculation. .The reaction type of these potatoes may be designated as escape resistance due to more or less hypersensibility, combined with progressive inactivation of the virus, when it occasionally becomes more or less systemic (Juli, test nr.

1134). The latter is true in the *Solanum demissum* hybrid "A-6" of Köhler, in which was found systemic virus in yellow, but nonnecrotic top leaves, although no virus could be found in the lower part of the stems, roots or tubers (test no. 1177) or in progeny plants next year.

The other tuber-forming Solanum species tested reacted in some cases like the commercial potato varieties; in other cases, they were systemically infected and carried the virus from one generation to the next through the tubers. In potato breeding work descendants of such "wild" potatoes should be tested for TMV susceptibility.

The collection of "wild" potato species was kindly supplied by Director B. Jacobsen of the potato breeding station at Vandel, Denmark (Landbrugets Kartoffelfond) and by Mr. Hjerting, one of the collectors. The A-6 hybrid has been obtained by the courtesy of Dr. E. Köhler, Germany.

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A RAPID METHOD FOR THE DETERMINATION OF SULFUR DIOXIDE IN SULFITED PRE-PEELED POTATOES[1]

L. R. Ross and R. H. Treadway[2]

The pre-peeled potato industry has become sizable since about 1947. It is estimated that approximately 5 million bushels of potatoes are now processed in central peeling plants for sale as whole potatoes or French fry slices (6). Most of this output is sold for restaurant and institutional use, but some attempts have been made to establish a retail pack.

A series of publications (1, 2, 5, 7, 8, 10, 13) describe the treatment of raw, peeled potatoes to prevent discoloration. A sulfite, such as sodium bisulfite, is usually employed with or without an acid, such as citric, to inhibit the enzymatic oxidation causing discoloration. While a method is available for determining the concentrations of sodium bisulfite and citric acid present in a dipping bath (8), no simple method has been available, to the best of our knowledge, for determining the amount of sulfite present in fresh potatoes. Such determination is usually made as sulfur dioxide, which is liberated from bisulfite when it is acidified. An easy, reliable method is needed for plant control and for furthering research on factors affecting the sulfur dioxide pickup and retention in peeled potatoes. While it is believed that the residual sulfur dioxide in commercial pre-peeled potatoes is nearly always below the maximum set by the several states having regulations, absence of a simple method has made it difficult for processor and user to establish the sulfur dioxide content of much of the product now on the market.

Much attention has been devoted to methods of determining sulfur dioxide, principally in dried fruits and vegetables. The Monier-Williams method (3) has long been considered as more or less the standard procedure. However, it is rather difficult to execute and is laborious. Ponting and Johnson (11) developed a method for determining sulfur dioxide in fruits in which the sulfur dioxide is extracted in buffered sodium chloride solution and the filtered extract titrated with iodine solution. The various procedures for determining sulfur dioxide were recently considered by Nury and others (9), who modified previous methods to develop a colorimetric procedure for use with dried fruit.

The method described here for determining the sulfur dioxide in sulfited, fresh potatoes can be carried out quickly, easily, without complicated equipment, and by one who has not had formal training in chemical analysis. While this method represents modifications of prior methods for iodometric determination of sulfur dioxide content of dehydrated food products, it employs a set of conditions that have been found to give good results with fresh potato.

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Apparatus

Blendor—10,000 RPM, 1-liter size, Waring type[3].

Graduated cylinders—5, 10, 100, and 500 ml. sizes.

Trip scale or torsion balance capable of weighing 100 grams ± 0.1 gram.

Timer, watch, or clock with sweep-second hand.

Filter paper, folded, Whatman #14 type.

Beakers—250 and 400 ml. sizes.

Items for stirring—magnetic stirrer with 1½ inch "Teflon"-covered magnetic stirring bars for use with 250 ml. beakers, or 250 ml. Erlenmeyer flasks (if manual stirring is employed in procedure).

Pipette—50 ml.

Burette—50 ml. with 0.1 ml. graduation.

Funnels—5 inch diameter.

Funnel rack.

Bottle—glass-stoppered, dark glass or covered with dark material or paint to exclude light, to serve as container for 0.01 Normal iodine solution.

Reagents

Special Buffer Solution. Dissolve 35 grams citric acid monohydrate and 65 grams disodium phosphate hepta-hydrate in distilled water, add 0.5 ml. toluene as preservative, and dilute to 1 liter. This buffer has a pH of 4.4 after dilution to 5 times its original volume, as practiced in the procedure.

Iodine, 0.01 Normal Solution. Dissolve 12 grams iodine and 22 grams potassium iodide in a minimum amount of water, dilute to 9 liters, and standardize against 0.01 Normal sodium thiosulfate or arsenius oxide solution according to the A.O.A.C. method (4). Store the iodine solution in a dark bottle

Hydrochloric Acid. Concentrated, A.C.S. grade.

Formaldehyde. 28 per cent Solution, A.C.S. grade.

Starch Indicator Solution, 1 per cent. Mix 10 grams soluble starch, 25 grams potassium iodide, 10 grams sodium bicarbonate (A.C.S. grade), and 0.01 gram mercuric iodide (preservative) in hot distilled water and dilute to 1 liter with the hot water. Mix for four minutes in the Waring-type blendor.

"Santocel C". Used as a filter aid.

"Regular" Procedure

Weigh out approximately 100 grams of sulfited potatoes, to the closest 0.1 gram, and place the sample in a 500 ml. graduated cylinder. This size of sample represents approximately 20 pieces, with French fry slices ⅜" x ⅜" x 2". With whole, peeled potatoes, take slices from about 10 potatoes and weigh out the approximately 100 grams. Add 100 ml. of the buffer solution and dilute to 500 ml. with tap water. To compensate for the volume occupied by the insoluble material in 100 grams of potato, add an extra 12 ml. of water. Transfer the contnets of the graduated cylinder to

[3]Mention of specific manufacturers or products in this paper does not imply endorsement by the U. S. Department of Agriculture over others not mentioned.

the blendor, add 1 heaping teaspoonful of "Santocel C" as a filter aid, note the time, and mix for exactly 2 minutes. Filter through the folded filter paper into a 400 ml. beaker. If excessive turbidity is encountered in the first portion of the filtrate, return this portion to the funnel for a second pass.

With employment of magnetic stirring in the titration, place a stirring bar in a 250 ml. beaker and pipette 50.0 ml. of the filtered sample into the beaker. Titrate the iodine solution into the periphery of the liquid to prevent holdup in the foam in the center of the vortex. Erlenmeyer flasks of 250 ml. capacity are convenient for swirling manually the 50 ml. sample during titration. Place 10 ml. of the starch indicator solution in the titration vessel and fill the burette with the standardized 0.01 Normal iodine solution. Begin the titration exactly 5 minutes after homogenization was started in the blendor. The titration must be carried out rapidly and continuously to prevent less rapid side reactions from becoming significant. Use of a magnetic stirrer greatly facilitates execution of a fast titration. A few practice titrations will enable the analyst to perceive accurately the end point, which is the first medium blue color that persists for 20 seconds.

The blank or control value is determined promptly on a 50 ml. aliquot of the same filtrate from which the sample was taken. Add 2.5 ml. of the hydrochloric acid and 10 ml. of the formaldehyde solution, stir, and let stand for 10 minutes to bind the free sulfur dioxide (12) and permit determination of the reducing power of the potato substances only. Add 10 ml. of starch indicator and titrate in a manner similar to the aliquot under determination. Occasionally, blank titrations produce an off-color end point. This difficulty can be remedied by the use of an additional 20 ml. of starch indicator when necessary. With only a slight loss in accuracy, time may be saved by running only one set of duplicate blanks for each batch of samples.

Calculation. Subtract the blank titration ml. from the sample titration ml. to get the corrected ml. of iodine solution to be used in the computation. Multiply the corrected ml. of iodine solution by the normality factor to obtain a measure of the iodine used; this is further multiplied by 0.03203 to obtain the weight of sulfur dioxide in grams equivalent to the iodine used. This weight of sulfur dioxide is to be expressed in parts per million of potato. The sample weight of potato is multiplied by 0.1 since a one-tenth aliquot of the extract was taken for titration.

$$\text{Then, } SO_2 \text{ in P.P.M.} = \frac{\text{corr. ml. } I_2 \times \text{Normal. } I_2 \times 0.03203 \times 1{,}000{,}000}{\text{sample wt.} \times 0.1}$$

Optional Laboratory Procedure for Maximum Accuracy

The "regular" procedure given above is intended for use in a peeling plant for ordinary control of the sulfur dioxide content of the finished product. While the simplicity makes it possible for a person with little or no chemical training to use this procedure after some practice, it also gives acceptable results for research purposes. If, however, one desires greater accuracy than permitted by the blank correction in the regular procedure, then a correction curve may be plotted.

More specifically, the procedure for determining sulfur dioxide with maximum accuracy is as given below:

Standardize 0.01 Normal sodium bisulfite solution against 0.01 Normal iodine solution. This standardized bisulfite solution is used to introduce known amounts of sulfur dioxide. Prepare for sulfur dioxide determination the following mixture in a 500 ml. graduated cylinder: 100 grams of unsulfited potatoes (from same lot from which the sulfited unknown is taken), 100 ml. of standardized sodium bisulfite solution, and 100 ml. of the buffer solution. Dilute to 500 ml. with water (adding 12 ml. extra water to compensate for the volume of insoluble solids in the 100 g. potato sample), transfer to blendor as described under the "regular" procedure, and homogenize. Filter, and titrate 50 ml. aliquots of filtrate every 5 minutes with standard iodine solution. Run correction controls, containing formaldehyde and hydrochloric acid as under the "regular" procedure, along with each aliquot and correct the titres accordingly. The optimum time to be used for the waiting period before making the titration of the unknown is found by taking the point on the time-iodine-titration curve where the corrected ml. iodine solution used equals that used in titrating 10 ml. of the sodium bisulfite solution alone.

Discussion

Achievement of quantitative extraction of the sulfite was the greatest single difficulty encountered. Oxidation of the sulfite and reaction of the free sulfite with the interior of the potato exposed during disintegration had to be minimized. Homogenizing the potato sample with water in a Waring-type blendor to extract the sulfite proved superior, in our experience, to distilling the sulfur dioxide (after acidification) or pressing out the juice under a carbon dioxide blanket. Still, the air bubbles stirred in by the blendor caused much oxidation of the sulfite under ordinary conditions. It was found that adjustment of the pH to 4.4 with a buffer would permit 2-minute mixing in the blendor without any detectable oxidation of the sulfite. This mixing time proved to be adequate to extract the sulfite.

The use of a time-tration curve in connection with the maximum-accuracy, alternative procedure was decided upon as a result of the following reasoning. Because of the several side reactions involving sulfur dioxide, the iodine required to reach the end point is not initially the theoretical value that would be obtained due to the sulfur dioxide alone. With some lots of potatoes, titres made soon after homogenization of the potato sample in the buffer solution are greater than theoretical; with other lots, they are less. However, it was found in every case that the titre-time curve eventually crossed the line of the theoretical titre value. This point of crossing, which gives the optimum time (after homogenization) should be determined on a representative sample from each lot of potatoes to be tested. Then a representative sample of the sulfited potatoes from the same lot can be assayed for sulfur dioxide, titrating the unknown at the optimum time after homogenization.

The usual filter aids gave slow filtration of the dilute potato macerate and absorbed some of the sulfite. Rapid, clear filtration without sulfite loss was attained by use of "Santocel C".

Precision. Table 1 presents a set of data that establish the "regular" sulfur dioxide determination as satisfactory from the standpoint of reproducibility. Nine samples were taken from the same lot of potatoes, and sub-samples were then selected to provide replication within a sample. In Table 1, mean values of sulfur dioxide content are calculated in parts per million and the standard deviations are expressed in parts per million sulfur dioxide. The percentage coefficient of variation ranged from 2.28 to 5.56, with a mean of 3.55.

Accuracy. The accuracy of the determination of sulfur dioxide in sulfited, pre-peeled potatoes by the "regular" procedure described here was ascertained by establishing that values obtained for known amounts of sodium bisulfite added to potato were near the true values when the titres were corrected for the blank titres. Table 2 presents data on the sulfur dioxide found in several samples of potatoes, to which specified amounts of sulfur dioxide had been added as sodium bisulfite.

TABLE 1.—*Parts per million of sulfur dioxide found in sulfited, pre-peeled potatoes.**

	Sample Numbers								
	1	2	3	4	5	6	7	8	9
Replicates A	440	387	330	318	266	214	197	158	112
B	431	376	342	298	264	222	187	153	125
C	420	358	358	300	278	203	196	..	117
Mean	430.3	373.7	343.3	305.3	269.3	213.0	193.3	155.5	118.0
Std. Dev.	10.02	14.64	14.05	11.02	7.57	9.54	5.51	3.54	6.56
Per cent Coef. Var.	2.33	3.92	4.09	3.61	2.81	4.48	2.85	2.28	5.56

Mean per cent Coef. Var. = 3.55

*All the potatoes used in these determinations were from a single lot (Katahdin, L. I., New York); sulfur dioxide determinations were made by "regular" procedure, with blank titres used for corrections.

TABLE 2.—*Accuracy of sulfur dioxide determinations by "Regular" method on potato samples containing known parts per million of sulfur dioxide.*

Sample	Determinations Averaged	P.P.M. SO_2 Added	P.P.M. SO_2 Found	Per cent Error
1	4	163	171	+4.9
2	5	120	128	+6.7
3	4	248	243	—2.0

SUMMARY

A simple method has been developed for determining the sulfur dioxide content of sulfited, fresh potatoes. A 100 gram sample of potato is homogenized in a buffer solution at pH 4.4, which was found to reduce the oxidation of the sulfite to a negligible amount during the extraction and subsequent filtration. An aliquot of the filtered extract is then titrated with iodine solution, using starch indicator.

Moderate accuracy was obtained by titrating an unknown 5 minutes after the potato was homogenized in the buffer solution, and correcting for the effect of the potato constituents by subtracting the titre of the blank. Maximum accuracy was obtained by plotting a time-titration curve and selecting the optimum time (after homogenization) for titrating the unknown. The optimum time varied from lot to lot of potatoes.

The sulfur dioxide content is computed as parts per million of potato.

Acknowledgment

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ALASKA 114, A TOUGH-SKINNED MAIN CROP POTATO[1]

C. H. Dearborn[2]

Alaska 114 was released to members of the Alaska Certified Seed Growers Association in 1954. The selection was made among seedlings of a cross of Cobbler x Minnesota 13-1.

Several thousand seedling tubers from this cross were obtained from Minnesota by Dr. Z. M. Fineman and increased at Fairbanks for the first time in 1944. Numerous selections from this group were subsequently brought to Matanuska where this final selection was made in 1953. It was tested under code number 114.42-3-44.

The code of Alaska 114 is as shown:

Alaska 114
- 13-1
  - Russet Burbank
  - x
  - 66-1
    - Katahdin (selfed)
- x
- Cobbler

Description

Plants: Medium, erect, full; *stems*, medium thick, prominently angled; *nodes* slightly swollen, slightly pigmented. *Internodes* short to medium, pigmented reddish purple. *Wings* short, smooth, slightly pigmented to green. *Stipules* green, small, slightly pubescent. *Leaves* medium, closed, deep green, smooth. *Midribs* green, scantily pubescent. *Petioles* green, short to medium. *Terminal leaflets* medium size, cordate. *Primary leaflets* medium size, two pair. *Secondary and tertiary leaflets* few. *Inflorescence* branched, large. *Leafy bracts* rare. *Peduncles* in axis of petiole and main stem, pigmented reddish purple. *Pedicels* long, much pigmented, scantily pubescent.

Flowers: *Buds* distinctly pigmented, oblong. *Calyx* lobes medium length, not foliaceous, tips recurved slightly. *Corolla*, medium size, lavender, showy. *Anthers*, yellow, not deformed, pollen abundant, very good quality. *Style* straight, fragile. *Stigma* three-lobed and pale green.

Tubers: Uniform, short, thick, oblong. Mean length 70.6 $\pm$ 0.5 mm. (2.7 in.), mean width 60.0 $\pm$ 0.4 mm. (2.3 in.). Mean thickness 45.9 $\pm$ 0.3 mm. (1.8 in.). *Skin* smooth to slightly scurfy, white. *Eyes*, medium to shallow, well distributed. *Eyebrows* small, not conspicuous. *Flesh* uniform, white. *Sprouts* distinctly reddish-purple at base when developed in the dark. *Maturity* late.

Characteristics

Alaska 114 is a medium vine type plant not sensitive to leaf necrosis common to the foliage of Green Mountain in the major potato producing areas of the State. The medium thickness of stems makes for easy vine removal with a mechanical beater.

[1]Accepted for publication July 29, 1959
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Tubers are very uniformly short, thick, oval in shape with an exceptionally tough skin at medium to late stage of tuber maturity. It is this tough skin characteristic and uniformity of appearance that prompted its release. Alaska 114 develops 6 to 8 tubers per hill and in seasons of moderate rainfall yields comparable to varieties such as Kennebec, Green Mountain and Ontario. In dry seasons or when grown on a low fertility level, many tubers remain small at harvest.

The skin of Alaska 114 is buff in color (known in the trade as white) and the flesh is uniformly white. Hollow-heart has been troublesome in a few instances on nearly all sizes of tubers indicating an unfavorable growing period for the tubers later than usual in the season.

Alaska 114 is not subject to storage rots, sprouting in storage or development of sprout-tubers when planted in cold soils. It is susceptible to common scab. Nothing is known regarding its reaction to early or late blight, because these diseases have not been present during the trial period. The variety has a very pleasant and distinctive flavor similar to its Cobbler parent. After-cooking darkening has been practically *nil* on Alaska 114. It has been judged as equal to Green Mountain for eating qualities, especially when baked. A considerable tonnage has been used for chipping and French frying, further attesting to its value as a commercial variety.

Yield, Storage and Market Characteristics

Alaska 114 has been tested in replicated trials with the highest yielding, best quality varieties grown in the State. It compares favorably with Green Mountain and Kennebec in yield and total solids as is shown in Table 1.

Table 1.—*Six year average of yields of U. S. No. 1 size tubers of Alaska 114 and other adapted varieties from 1953 through 1958.*

Variety	Yield		Total Solids	
	Matanuska	Fairbanks	Matanuska	Fairbanks
	Cwt. per acre		Per cent	
Alaska 114	307	144	22.3	21.3
Green Mountain	308	172	23.4	21.9
Kennebec	305	193	22.6	21.3

Significantly lower yields in the Fairbanks area for all varieties are associated with drier growing conditions at that location A difference of 1 per cent in total solids is statistically significant at the 5 per cent level. In most cases in Alaska a 1.0 per cent difference in total solids is significant at the 1 per cent level

Under normal harvesting conditions in Alaska the skin of most potato varieties "feathers" badly. Immediately following harvest, tubers are stored directly in cold, damp storages where the temperatures (38° to 45° F.) are too low for most rapid healing of bruised areas.

The tough skin of Alaska 114 affords the tubers a significant amount of protection from feathering at harvest. Losses in tonnage at harvest due to bruising were materially less from Alaska 114 than from Green Mountain as shown in Table 2.

TABLE 2.—*Losses caused by mechanical damage during harvest in 1956 and 1957, expressed as per cent of 900-pound samples of Alaska 114 and Green Mountain.*

Time of Loss	Alaska 114	Green Mountain
October (at harvest)	1.1	10.6
December (from storage)	5.1	21.1
March (from storage)	10.0	33.1
Average loss	5.4	21.6

At the end of a 6 months storage period the grade-out from Alaska 114 was equivalent to what had to be removed from Green Mountain at harvest to get the same sample appearance. The grade-out from Green Mountain 6 months after storage was three times that for Alaska 114.

When bruising is not carefully controlled the market value per acre of Alaska 114 is obviously higher than Green Mountain. Furthermore, when losses due to mechanical damage run as low as measured on this new variety the consumer has a higher per cent of undamaged tubers per bag of U. S. No. 1 grade potatoes.

SUMMARY

Alaska 114 is a medium vine type potato producing a very uniform size and shape tuber. It has a tough skin, yields well, stores well, has good culinary qualities and exhibits significantly less after-cooking darkening than Green Mountain. *Phytophthora infestans* has not been observed on potatoes in Alaska since this variety has been under test so its susceptibility to late blight is not known.

NEWS AND REVIEWS

ABSTRACT

Differential host and serological relationships of potato virus M, potato virus S, and carnation latent virus. Phytopathology 49: 435-442, 1959.

R. H. Bagnall, C. Wetter and R. H. Larson

Potato virus S (2 isolates) an two other viruses, potato virus M (6 isolates) and carnation latent virus, each reputed to be distantly related to virus S, were compared. CLV, unlike virus S and virus M, did not infect solanaceous plants. In host range and in symptomatology, the virus S isolates behaved as one group and the virus M isolates as another quite distinct group. Virus S could be isolated from a mixture of the two by systemic passage through *Nicotiana debneyi* L., whereas virus M, but not virus S, infected tomato and Saco potato.

One isolate of virus M was obtained from leafrolling mosaic-diseased but not from "healthy" Green Mountain potato. This was evidently the aphid-borne factor to which the disease was originally attributed by Schultz and Folsom in 1923. Other isolates of virus M were obtained from interveinal-mosaic-diseased Irish Cobbler, paracrinkle-carrying King Edward, and outwardly healthy Fortuna, seedling D1102 and Bintje potatoes. Green Mountain and Irish Cobbler, whether apparently healthy or diseased, were infected with potato virus X, while these and the other sources of virus M, save Bintje, carried virus S.

The different isolates of virus M differed in their abilities to incite complex diseases in several potato varieties, and they showed minor variations in differential host symptomatology. Serologically, the virus M isolates were closely related, and were more distantly so to virus S and to CLV. Cross-absorption tests indicated that virus S, virus M, and CLV each have a major antigenic fraction distinct from the others, whereas viruses S and M each have a distinct fraction in common with CLV. There also appears to be a small antigenic fraction common to all three, but the existence of any distinct fraction common only to viruses S and M is uncertain.

The relationships between virus S, virus M, and CLV are seen to be similar to that existing between cucumber virus 3 and tobacco mosaic virus, rather than to the numerous close relationships that have been reported between virus "strains." The three are therefore regarded as distinct viruses rather than as "strains," the latter term being reserved for lesser variants already known to exist amongst the virus S and virus M isolates.

CALL FOR PAPERS

The 44th Annual Meeting of the Potato Association of America will be held at the American Baptist Assembly at Green Lake, Wisconsin, August 28-31.

Please send titles of papers to be presented at this annual meeting to Richard L. Sawyer, Long Island Vegetable Research Farm, Cornell University, Riverhead, New York, by May 15. Along with the title please include: (a) approximate time required to present your papers, (b) if an illustrated talk, the size of the slides to be used, and (c) the names and official addresses of the authors as you wish them to appear on the program. As has been our custom, we will again distribute mimeographed abstracts of these papers to members attending the annual meeting. These abstracts will be published in the American Potato Journal. Therefore, they should accompany the titles of the papers and should not exceed 250 words. Presentation of papers should not exceed 15 minutes, and the use of 2 x 2 slides is preferred.

We would like to receive good papers concerned with problems in potato breeding, diseases, production, quality, nutrition, storage, transportation, and marketing.

Your cooperation in sending the titles and abstracts as early as possible will aid in the mimeographing of these abstracts and the prompt preparation and printing of programs. Titles and abstracts received after our deadline of May 15 may not be accepted. Please bring this notice to the attention of your students and colleagues.

R. L. SAWYER, *Secretary*

USDA DEVELOPS NEW CONVEYOR TO MOVE POTATOES INTO STORAGE

A lightweight 40-foot conveyor supported from a ceiling track has been developed for use in filling potato storages. It is described in a report issued by the U. S. Department of Agriculture.

Researchers of USDA's Agricultural Marketing Service designed and built the convevor at the Red River Valley Potato Center, East Grand Forks, Minn. The conveyor is the latest result of research to develop improved methods and equipment to move potatoes into deep-bin storages typical of those in the Red River Valley of North Dakota and Minnesota.

The lightweight conveyor permits potatoes to be moved into storage at a rate of one truckload in 10 minutes. It causes fewer injuries to the potatoes than the conventional canvas chute now used commercially. Cost of the conveyor and auxiliary equipment is about $1,700, the report states.

Research on which this report is based is part of USDA's broad program to reduce the cost of marketing farm products. A free copy of the report, "A Light-Weight Conveyor for Filling Deep-Bin Potato Storages," AMS-362, may be obtained from the Marketing Information Division, Agricultural Marketing Service, U. S. Department of Agriculture, Washington 25, D. C.

PROBLEMS IN STORING FALL-HARVESTED POTATOES STUDIED

Recent research findings on the storage of potatoes are given in a report issued by the U. S. Department of Agriculture.

The report deals with methods and equipment for obtaining optimum storage temperatures, humidities, and airflow rates ,and contains information on designing, constructing, anad operating commercial potato storages. It is part of a broad program of research to improve marketing of farm products.

The Agricultural Marketing Service, in cooperation with the Cornell University Agricultural Experiment Station and the New Jersey Agricultural Experiment Station conducted the research primarily with fall-harvested potatoes in the northeastern summer crop area, particularly Long Island.

Fall-harvested table stock potatoes can be stored for as long as 6 months in the northeastern late summer crop are. These potatoes keep best at a temperature as near 40° F. as possible. Storages built above ground are more efficient than below ground, although they require adequate insulation against both excessive heat in the fall and cold in the winter. Below-ground storages are most costly to ventilate and are not so adaptable for other uses.

A copy of the report, "Storage of Fall Harvested Potatoes in the Northeastern Late Summer Crop Area," Marketing Research Report No. 370, may be obtained free from the Office of Information, U. S. Department of Agriculture, Washington 25, D. C.

NEW MODERN POTATO STARCH FACTORY OPENED IN SWEDEN

A new factory for the production of potato starch, incorporating many time and labor saving ideas, has just opened at Jamshog, in southern Sweden. It replaces not less than sixteen old plants, and constitutes a new stage in the radical streamlining of the Swedish starch industry, which today comprises seventy plants against double as many ten years ago. In the immediate future, the Swedish Starch Producers Association plans to set up one new modern central plant each year.

The Swedish production of potato starch is at present about 25,000 tons a year, all consumed within the country, which has a population of somewhat more than seven million. For this production, about 125,000 tons of potatoes are used annually. The most commonly used brands are "Dinella" and "Parnassia," since only particularly starch-rich potatoes are acceptable. More than 200 growers deliver their potatoes to the new plant at Jamshog.

The factory keeps running in three shifts day and night, including Sundays and holidays. The employees number only eleven men, plus a chief grater, another evidence of the ultra-modern machinery used, permitting the factory to operate with such a small staff. During the peak manufacturing period, from about September 20 until Christmas, the total

capacity of the plant is 18,000 to 20,000 decitons (one deciton = 200 pounds) of potato starch.

A technical novelty of importance at this plant is the great recapture of water that has been achieved. This has made it possible to reduce the amount of fruit water to 2.0 to 2.5 cubic meter per deciton (two hundredweight) against approximately 4 cubic meters in old plants. The fruit water is then spread out as a liquid manure by means of twenty powerful water guns over the acres near the plant. The area thus watered covers about 200 acres. Through this ingenious method of watering, the area is supplied with 220 lbs. of nitrogen, 275 lbs. of potash, and 33 lbs. of phosphoric caid per each 2.5 acres of land.

NOW...YOUR POTATOES CAN KILL INSECTS

One application of Thimet® Insecticide Granules at planting builds extra-long systemic insect control into your crop

Powerful Thimet Insecticide Granules let you do practically all your insect control at planting time. No more spraying, no more dusting for most of the bugs that damage the crop.

What Thimet is, how it works

Thimet is a systemic insecticide. It actually enters and protects the entire plant. Thimet is supplied to potato growers in granular form and is applied in bands along the row, at planting. As the crop starts to grow, the roots pick up the Thimet and send it up to the leaves, making them toxic to insects. Thimet provides even, steady control right through the season. Thimet eliminates the need to "time" insecticide applications.

Insects controlled by Thimet

In many major potato areas, Thimet gives season-long control of aphids and leafhoppers; reduces flea beetle infestations. Because it stops leafhoppers, it helps control "purple top." In areas where late-season build-up of insects occurs, supplementary use of a conventional insecticide may be necessary.

Experiment Station tested

In Experiment Station tests, potatoes treated with Thimet consistently produced larger yields than unprotected potatoes. And, with Thimet, yields have often been higher than potatoes protected with conventional sprays.

No effect on quality

There are no residues in tubers at harvest, nor are chipping qualities affected when Thimet is used at recommended rates. Tests at Experiment Stations in Wisconsin and Ohio prove Thimet has no effect on flavor or chipping quality.

Rates

On heavy or upland soils, apply 30 lbs. of Thimet 10% Granular Insecticide; on sandy or light soils apply 25 lbs. Do not use Thimet on muck soils. Be sure to follow directions and precautions printed on the package.

Try Thimet 10% Granular Insecticide this season. Ask your County Agent and Insecticide Dealer about Thimet and the low-cost applicators that assure effective flow and placement. Write for free leaflet PE 5095. American Cyanamid Company, Agricultural Division, New York 20, New York. *®THIMET is American Cyanamid Company's trademark for phorate.*

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